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Contributions to the Mesozoic flora of the Atlantic coastal plain—
III. New Jersey *

EDWARD W. BERRY

(WITH PLATES 18 AND 18a)

The present brief contribution includes additions and corrections to our knowledge of the fossil flora of the Raritan formation of New Jersey and embraces certain results obtained during a monographic revision of this flora for the Geological Survey of that state which it is desirable to publish in advance of the completed work for the purpose of intelligent citation in connection with the investigation of similar floras from the southern coastal plain.

It is now nearly twenty years since Professor J. S. Newberry, through failing health, was compelled to stop work upon the Raritan flora. In this interval there has been no published addition to our knowledge of this flora except Dr. Arthur Hollick's admirable work in preparing Professor Newberry's manuscript for publication.

Much new material has been collected by the writer and others, all of which has been passed in review and the ranges of many of the species have been greatly extended. It is not my purpose, however, to give any extended discussion or lists of species at the present time, but simply to indicate certain taxonomic changes made necessary by the progress of our knowledge of certain forms or by our present ideas of their specific segregation. Synonymy is omitted wherever possible, as is any lengthy discussion of the species mentioned.

DICKSONIA GROENLANDICA Heer, Fl. Foss. Arct. 6²: 23. *pl.* 35. *f.* 8,
9. 1882; 7: 2. *pl.* 48. *f.* 1-3. 1883

Dicksonia borealis Heer, *op. cit.* 6²: 23. *pl.* 44. *f.* 2. 1882. Not
Heer, 1878, a distinct Jurassic type.

Anemia stricta Newb. Fl. Amboy Clays 38. *pl.* 3. *f.* 1, 2. 1896.

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Both of Heer's types which are here united with Newberry's species are small fragments of ultimate pinnae, which their author confesses are very similar, a fact well brought out by a comparison of the figured specimens. The material from Woodbridge, N. J., is more ample, and, as may be seen lower down on the frond, the pinnules become toothed and finally pinnatifid, a feature not shown in the scant material from Greenland. There is slight reason, however, for doubting their identity, Newberry himself having pointed out that *Dicksonia borealis* of Heer was probably identical with his Amboy Clay species.

Although common at Woodbridge, this species has not been found elsewhere in the coastal plain except for a single specimen which the writer discovered recently in the Tuscaloosa formation of Alabama. It is present at both the Atane and the Patoot horizons in Greenland.

OCCURRENCE : Woodbridge.

COLLECTIONS : New York Botanical Garden.

***Asplenium raritanense* sp. nov.**

Frond and pinnae unknown. Pinnules small, 1.33 cm. long by 10 mm. in greatest breadth, ovate, with narrow somewhat straight-sided base, palmately divided into one terminal and two pairs of lateral, rounded, not deeply parted lobes; margin entire at base and in sinuses, sharply toothed on the lobes. Venation flabellate; about seven veins entering the base of the pinnule, these soon forking dichotomously, the ultimate divisions terminating in the marginal teeth. [PLATE 18, FIGURE 1.]

This species, which is quite unlike anything heretofore known from the Raritan formation, is unfortunately based on the single tiny pinnule figured. The general form and habit remain unknown. It is markedly distinct from any described fossil species known to the writer, although showing some points of resemblance to various arctic species referred to this genus by Professor Heer. Since the chances of more representative material being found are remote, it has seemed best to describe it under the above name.

OCCURRENCE : Hylton Pits.

COLLECTIONS : Johns Hopkins University.

Podozamites Knowltoni nom. nov.

Podozamites angustifolius (Eichw.) Schimper, Pal. Végét. 2: 160. 1872. — Lesq. Cret. & Tert. Fl. 28. 1884; Fl. Dakota Group 27. *pl.* 1. *f.* 4. 1892. — Newb. Fl. Amboy Clays 44. *pl.* 13. *f.* 1, 3, 4 (not *f.* 2). 1896. Not Schenk, 1868.

Zamites angustifolius Eichwald, Lethaea rossica 2: 39. *pl.* 2. *f.* 7. 1860.

In 1872 Schimper referred the *Zamites angustifolius* of Eichwald to the genus *Podozamites*, overlooking the fact that Schenk, four years earlier, had described and named a *Podozamites angustifolius*. The natural impulse would be to dedicate this to Eichwald but Eichwald has already had a species of *Podozamites* named for him, in consequence of which the above name is proposed in honor of Dr. F. H. Knowlton, of the U. S. National Museum. This species has a wide range both geological and geographical. It is common in the Jurassic of high latitudes in Russia, Siberia, Bornholm, and Spitzbergen, and in the Upper Cretaceous indistinguishable remains are widely distributed in America. The abundant Raritan remains are long-lanceolate, 5–15 cm. in length by 0.6–1.2 cm. in width, the base narrowed to a short petiole, the summit long-pointed and the venation fine. They are similar to the leaflets of *Podozamites lanceolatus* but are usually longer, narrower, and more flexuous in outline.

OCCURRENCE: Woodbridge.

COLLECTIONS: New York Botanical Garden.

Pinus raritanensis Berry

Pinus sp. Newb. Fl. Amboy Clays 47. *pl.* 9. *f.* 5, 6, 7, 8 (?), 17, 18 (?). 1896.

It seems very desirable that at least the leaves which are included under Newberry's *Pinus* sp. should have a specific name, since pine leaves of this type in fascicles of three occur to the southward in the coastal plain and a definite name is therefore a necessity for purposes of intelligent citation. Whether the poorly preserved cones and winged seeds which occur in the same beds are referable to the same species, it is impossible to determine, and since in the overlying Magothy formation there are two types of leaves of *Pinus* as well as quite different seeds I have placed a

query after Newberry's figures of cones and seeds in the above citation. *Pinus* seems to be confined to the upper part of the Raritan, although leaves, cones, and seeds are common in much older deposits elsewhere, going back as far as the Jurassic. Leaves are recorded from the Kome, Kootanie, Trinity, and Lakota formations; the Albian of Europe is remarkable for the large number of *Pinus*-like cones which it contains and Heer has recorded five species from the Atane beds.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Smilax raritanensis* sp. nov.**

Paliurus ovalis Newb. Fl. Amboy Clays 107. *pl.* 23. *f.* 8, 9
1896. Not Dawson, 1886.

Leaves of small size, ovate-elliptical, with entire margins, obtusely pointed apex and slightly cuneate base, 3.5–4 cm. long by 1.5–2 cm. wide. Primaries three, of medium size, diverging at acute angles from the extreme base, the laterals regularly curving upward and joining the midvein at the summit. Secondaries not visible except one or two transverse internal ones, and a few curved camptodrome external ones.

This species was identified by Professor Newberry with *Paliurus ovalis* Dawson,* which it somewhat resembles, and this latter species has been reported by Lesquereux† from the Dakota group and by Hollick‡ from Marthas Vineyard. These occurrences may represent Dawson's species but the Raritan leaves are obviously different, being relatively shorter and broader and of an altogether different aspect.

Professor Newberry remarks of the difficulty of correlating these and other fossil species with the modern species of *Paliurus*, which usually has serrate or crenate leaves, and, while no new material has been obtained, it seems desirable to place these leaves in the genus *Smilax*, which contains many very similar modern leaves. Lesquereux describes two species of *Smilax* from the Dakota group, both of which are much larger-leaved and differ in other respects from the Raritan species.

* Dawson, Trans. Roy. Soc. Can. 3⁴: 14. *pl.* 4. *f.* 4, 8. 1886.

† Lesquereux, Fl. Dakota Group 166. *pl.* 35. *f.* 7. 1892.

‡ Hollick, Mon. U. S. Geol. Surv. 50: 91. *pl.* 34. *f.* 14. 1907.

OCCURRENCE : Locality unknown.

COLLECTIONS : New York Botanical Garden.

MYRICA HOLLICKI Ward, Amer. Jour. Sci. **45** : 437. 1893

Myrica grandifolia Hollick, Trans. N. Y. Acad. Sci. **12** : 5. *pl.* 3.

f. 1. 1892. Not Schimper, 1872.

Leaves of large size, 18–22 cm. in length by 4–6 cm. in width, broadly lanceolate, widest near the middle and tapering equally to the acuminate apex and the cuneate base. Margins entire for a short distance above the base, elsewhere sharply serrate. Petiole long and stout. Midrib also stout. Secondaries slender, very numerous, being not more than 2–3 mm. apart, branching from the midrib at angles of 45° or slightly more, subdividing and inosculating near the margin and sending branches into the marginal teeth. [PLATE 18, FIGURE 2.]

The type of this exceedingly handsome species is a single incomplete specimen collected at Tottenville, Staten Island, sixteen or more years ago and now preserved in the museum of the Staten Island Association of Arts and Sciences. A single specimen was collected from the Lower Raritan at Milltown. It is a larger, slightly broader leaf with slightly less prominent teeth but is obviously identical with the type.

OCCURRENCE : Milltown.

COLLECTIONS : U. S. National Museum.

***Quercus raritanensis* nom. nov.**

Quercus Johnstrupi Newb. Fl. Amboy Clays 69. *pl.* 19. *f.* 7. 1896.

Not Heer.

Leaves ovate, subcoriaceous, apparently about 8–9 cm. in length by 4.5 cm. in width, pointed above. Margin with coarse pointed teeth, separated by rounded sinuses.

The New Jersey occurrence of this species is based on the single obscure fragment of the terminal half of a leaf figured by Professor Newberry and identified with *Quercus Johnstrupi* Heer, a Greenland species. The New Jersey form is obviously not the same as Heer's, which has pointed instead of rounded sinuses and is a smaller, more *Myrica*-like leaf, with the marginal teeth dentate rather than serrate.

The present species considerably resembles an undescribed *Quercus* from the Cretaceous of North and South Carolina but

this resemblance cannot be construed as a proof of identity because of the incompleteness of the New Jersey material, consequently the present form is here renamed in allusion to the locality from which it was collected.

OCCURRENCE : Sayreville.

COLLECTIONS : N. Y. Botanical Garden.

***Populus orbicularis* (Newb.) comb. nov.**

Phyllites orbicularis Newb. Fl. Amboy Clays 130. *pl.* 24. *f.* 7, 8. 1896.

Leaves orbicular, very slightly emarginate and slightly decurrent from the rounded base to the apparently short petiole, length about 5 cm. and breadth usually two or three millimeters less than 5 cm. Margin entire. Midrib moderately stout. Secondaries camptodrome, relatively coarse, about 6 pairs, subopposite, branching from the midrib at a wide angle, less curved than in the preceding, and inclined to be somewhat flexuous.

Newberry calls attention to the resemblance of this species to *Populus hyperborea* Heer, but is quite positive that it is not related to *Populus*. The writer does not share this opinion. Unless we are prepared to discard *Populus* for *Phyllites* in a large number of cases this species should surely be referred to the former genus. It is a remarkable coincidence, referred to in the present connection only because of its general interest, that the type of Sternberg's genus *Phyllites* was very likely a true *Populus* and that *Phyllites* as a form genus for undeterminable leaves will probably have to be dropped eventually in favor of some other name.

The present species is based upon scanty but perfect material confined to the Sayreville horizon.

OCCURRENCE : Sayreville.

COLLECTIONS : N. Y. Botanical Garden.

***Salix raritanensis* nom. nov.**

Salix membranacea Newb. Later Ext. Floras 19. 1868 ; Fl. Amboy Clays 66. *pl.* 29. *f.* 12. 1896. Not Thuill, 1799.

Leaves broadly lanceolate, often unsymmetrical, large, petiolate, length about 13 cm. and breadth at the widest part, which is toward the base, about 3 cm. Base rounded and obtuse. Apex narrowed and acute. Texture smooth and thin. Midrib slender, somewhat curved. Secondaries remote, branching from the

midrib at an angle of 45° and curving upward in parallel courses, camptodrome.

This is another species of *Salix* which it is difficult to define with precision. If the emphasis is laid upon the large size, thin texture, and rounded base, we have characters which are easily recognized and which can be made constant by elimination. It is apparently common in the Lower Raritan and has been reported by Hollick (*loc. cit.*) from Marthas Vineyard, the latter horizon probably of Magothy age. I have queried the small leaf figured by Hollick from Kreischerville, Staten Island, as it seems to be of a different consistency although it may be only a small leaf of this species. The latter author has tentatively included *Salix mattewanensis* Berry, which comes from the Magothy formation at Cliffwood, N. J., under this species. This is, in the writer's judgment, perfectly distinct and represents a much smaller, less elongated leaf, of a different consistency and venation.

Unfortunately, the original name *Salix membranacea* is preoccupied, so that it becomes necessary to propose a new name.

OCCURRENCE: Sayreville, Woodbridge, Milltown.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Salix pseudo-Hayei* nom. nov.**

Salix sp. Newb. Fl. Amboy Clays 68. *pl. 42. f. 6-8.* 1896.

Leaves small, relatively short and broad, ovate-lanceolate, uniformly about 3 cm. in length by 1.1-1.4 cm. in greatest breadth, which is about half way between the apex and base. Apex acuminate. Base rounded. Margin entire. Petiole short. Midrib slender and slightly curved. Secondaries fine, obscured in some specimens, five or six pairs, alternate, camptodrome, branching from the midrib at an angle of about 45° and curving upward.

This species is not uncommon in the Raritan, although Professor Newberry fails to mention the exact localities from which he collected it. Later material has come from the Lower Raritan at Milltown. It has been compared with the Dakota group species, *Salix Hayei* Lesq., and with the arctic Tertiary *Salix Raeana* Heer, both of which it resembles in general appearance. The Dakota group leaf, however, is coriaceous, with a coarse venation, blunt apex, and more narrow pointed base and is seen to be quite different from the Raritan species when careful comparisons are made.

OCCURRENCE: Milltown.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Salix Lesquereuxii* nom. nov.**

Salix proteaefolia Lesq. Amer. Jour. Sci. **46**: 94. 1868. —
Newb. Fl. Amboy Clays 66. *pl.* 18. *f.* 3, 4. 1896. Not *Salix*
proteaefolia Forbes, 1829.

Salix proteaefolia longifolia Lesq. Fl. Dakota Group 50. *pl.* 64.
f. 9. 1892.

Proteoides daphnogenoides Newb. *p. p.*, Fl. Amboy Clays 72. *pl.*
32. *f.* 11 (not *f.* 13, 14). 1896.

Dewalquea grönlandica Newb. *p. p.*, *op. cit.* 129. *pl.* 41. *f.* 12 (not
f. 2, 3).

Leaves ovate-lanceolate, somewhat more acuminate above than below, variable in size, ranging from 6 to 12 cm. in length and from 1.1 to 2.2 cm. in greatest width, which is usually slightly below the middle. Petiole stout, much longer than in *Salix flexuosa*, ranging up to 1.2 cm. in length. Midrib stout below, tapering above. Secondaries numerous, sometimes as many as twenty pairs; they branch from the midrib at angles of about 45° and are parallel and camptodrome.

Unfortunately, the name given this species was used for another by Forbes in 1829 so that it becomes necessary to rename it, and no name can be more appropriate than that of its distinguished describer, Leo Lesquereux, to whom it is here dedicated.

This is an exceedingly variable species, as might be expected in a *Salix*, and Lesquereux established several varieties, of which at least one, *i. e.*, *linearifolia*, is referable to *Salix flexuosa* Newb. Some of Lesquereux's forms are distinguishable with difficulty from the latter and this is especially shown in the leaves which he figures on plate 1 of his Cretaceous and Tertiary Flora. They are, however, larger and somewhat more robust, of a thicker texture and broadest near the base, from which they taper upward to an exceedingly acuminate tip. In general, *Salix Lesquereuxii* is a relatively much broader, more ovate form with more numerous and better seen secondaries and a longer petiole. It is a characteristic Cenomanian species in both the east and the west and has even been reported from the Cretaceous of Argentina by Kurtz. It is

abundant in the Raritan formation both in the lower and upper beds.

OCCURRENCE: Sayreville, Woodbridge, South Amboy.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Ficus ovatifolia* nom. nov.**

Ficus ovata Newb. Fl. Amboy Clays 70. *pl.* 24. *f.* 1-3. 1896.
Not Don, 1802-03.

Leaves ovate 8-13 cm. in length by 4-7 cm. in breadth, petiolate. Apex extended, acute. Base rounded or somewhat descending. Margins entire. Principal veins three, from the base, the midrib being the stoutest and slightly flexuous. The lateral veins diverge at an angle of about 45° and curve upward, traversing somewhat more than the basal half of the leaf and connecting with branches from the lowest pair of camptodrome secondaries, of which there are several alternating pairs, which branch from the midrib at a wider angle. The laterals give off on the outside 8-10 camptodrome veins. Quadrangular areoles formed by nearly straight transverse nervilles fill all of the intervening space.

This species is very close to the same author's *Ficus Woolsoni*, which is a much less elongated, comparatively broader leaf, often with a cordate base in consequence.

The very appropriate name *ovata* is preoccupied, so that it becomes necessary to rename the Raritan species. It occurs also in the Bladen formation of North Carolina.

OCCURRENCE: Woodbridge.

COLLECTIONS: N. Y. Botanical Garden.

***Magnolia Hollicki* nom. nov.**

Magnolia auriculata Hollick, Bull. Torrey Club 21: 61. *pl.* 179.
f. 6, 7. 1894.—Newb. Fl. Amboy Clays 75. *pl.* 58. *f.* 1-9,
11 (not *f.* 10). 1896. Not *M. auriculata* Lamarck, 1783.

Leaves orbicular-ovate, 4-10 cm. in length by 2-5.5 cm. in width, petiolate. Apex acute, slightly extended in one or two specimens. Base rounded occasionally, usually pronouncedly auriculate. Petiole and midrib stout. Secondaries few, 6 or 7 pairs, subopposite, camptodrome. Texture smooth and subcoriaceous.

This magnificent species is abundant and well preserved at the Woodbridge locality and Marthas Vineyard and in the Magothy

formation of Maryland. Professor Newberry was somewhat uncertain as to its relationship with *Magnolia* and compared it with *Aristolochia*, *Polygonum*, and *Toxylon*. The latter is the only genus which is at all suggestive and it furnishes no instances of auriculate bases, while this character of a base prevails in more than one modern species of *Magnolia*. The outline, consistency, and venation are all in accord in pointing to *Magnolia* as the proper generic reference.

Unfortunately, the specific name *auriculata* had been previously used by both Lamarck and Desvaux in 1783 and 1789, so that the fossil species may well be renamed in honor of Dr. Hollick, who has done so much in the elucidation of the Cretaceous floras in the vicinity of New York.

OCCURRENCE: Woodbridge.

COLLECTIONS: N. Y. Botanical Garden.

MAGNOLIA BOULAYANA Lesq.

Magnolia Boulayana Lesq. Fl. Dakota Group 202. *pl.* 60. *f.* 2. 1892.

Magnolia glaucoides Hollick, Bull. Torrey Club 21: 60. *pl.* 175. *f.* 1, 7. 1894. — Newb. Fl. Amboy Clays 74. *pl.* 57. *f.* 1-4. 1896.

Leaves narrowly elliptical, usually uniform in size and shape, 8.5-13 cm. in length and 3.5-4.5 cm. in breadth. Apex usually bluntly rounded, sometimes acute. Base similar to the apex. Petiole moderately stout, 3-4 cm. in length. Midrib moderately stout. Secondaries slender, often obsolete, about 11 pairs, equidistant, parallel, camptodrome, branching from the midrib at an angle of about 40°. Tertiaries, when seen, transverse. Texture coriaceous.

This species was described originally from the Dakota group of Kansas. Professor Newberry described the Raritan remains, which are abundant at the Woodbridge locality, as a new species and it has been kept distinct by Hollick, who recognized however, its practical identity with the Dakota group plant. There can be no question but that they belong to the same species, which is also recorded from Marthas Vineyard and Long Island and from the Woodbine formation of Texas and the Tuscaloosa formation of Alabama.

OCCURRENCE: Woodbridge.

COLLECTIONS: N. Y. Botanical Garden.

LAUROPHYLLUM NERVILLOSUM Hollick, Mon. U. S. Geol. Surv. **50**:
82. *pl.* 27. *f.* 6, 7. 1907

Proteoides daphnogenoides Hollick, Ann. N. Y. Acad. Sci. **11**: 420.
pl. 36. *f.* 1, 3. 1898.

Leaves of comparatively large size, oblong-lanceolate, about 15 cm. in length by about 2.6 cm. in greatest breadth, which is about midway between the apex and base. Apex acuminate. Base pointed, narrowly cuneate. Midrib short. Secondaries thin, close, parallel, branching from the midrib at angles not exceeding and usually somewhat less than 45° , ascending, nearly straight or somewhat flexuous, branching and inosculating near the margin where they merge in the tertiary venation, connected by transverse nervilles.

This species was described originally from the terminal moraine at Tottenville, Staten Island, and undoubtedly represents transported Raritan materials. Three specimens are contained in the Milltown collection and the writer has also collected it from somewhat higher horizons south of New Jersey. It is somewhat like *Laurophyllum lanceolatum* Newberry but has a markedly different venation and a less lanceolate outline. It is also quite close to *Laurophyllum elegans* Hollick, which is, however, a more slender lanceolate leaf, with narrowly produced apex and base and a somewhat coarser venation, with less close and more curved camptodrome secondaries.

OCCURRENCE: Milltown.

COLLECTIONS: U. S. National Museum.

LAUROPHYLLUM ELEGANS Hollick, Mon. U. S. Geol.

Surv. **50**: 81. *pl.* 27. *f.* 1-5. 1907

Laurus plutonia Hollick, Trans. N. Y. Acad. Sci. **11**: 99. *pl.* 3.
f. 3, 4. 1892; **12**: 236. *pl.* 6. *f.* 1. 1893.

Proteoides daphnogenoides Hollick, Ann. N. Y. Acad. Sci. **11**:
420. *pl.* 36. *f.* 2. 1898.

Leaves elongate-lanceolate, somewhat flexuous, about 12-13 cm. in length by about 2 cm. in greatest width, which is about midway between the apex and the base; from this point they narrow gradually apically into an attenuated, acuminate, usually curved tip, and basally into a long, narrowly cuneate base. Midrib

stout, stouter than in *Laurophyllum nervillosum* Hollick. Secondaries numerous, usually less close and somewhat coarser than in the latter species, branching from the midrib at an acute angle below, which becomes more open above the base of the leaf; they are usually more curved than in *L. nervillosum* and more distinctly camptodrome. Tertiaries transverse throughout.

These leaves were recorded originally by Hollick as *Laurus plutonia* Heer and were later compared with *Laurus angusta* Heer, which latter species they resemble more than they do the former. In outline they are not unlike *Laurophyllum angustifolium* Newb., from Woodbridge, N. J., but differ decidedly in venation. They are also similar but quite distinct from *Laurophyllum nervillosum* Hollick, and *Laurophyllum reticulatum* Lesq. of the Dakota group.

The specimens outside of those recorded in the present contribution from New Jersey and those which are as yet unpublished from the region south of New Jersey, are from transported materials associated with the terminal moraine from which numerous specimens have been collected. Those from Tottenville, Staten Island, are undoubtedly of Raritan age, while those from Glen Cove may have been originally from the Magothy formation, although they are probably Raritan.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum.

PHASEOLITES MANHASSETTENSIS Hollick, Bull. N. Y. Botanical Garden 3: 414. *pl.* 78. *f.* 1, 2. 1904

Leaves ovate-falcate, markedly unsymmetrical, 6–7.5 cm. in length by 2.4–2.8 cm. in greatest breadth, which is below the middle of the leaf. Margins entire. Apex acute. Base cuneate. Petiole short and stout. Midrib stout and curved. Secondaries fine, about 9 pairs, often obsolete, diverging from the midrib at an acute angle. [PLATE 18, FIGURE 3.]

This species was described from Manhasset Neck, Long Island, a locality which should probably be included within the Raritan formation. The species is scarcely distinguishable from *Phaseolites elegans*, described by the same author from Brooklyn, and both are very close to the Dakota group *Phaseolites formus* Lesq., in fact, it is scarcely conceivable that these extremely limited variations are not all of a single species. However, they should be

allowed to stand until more abundant and complete material is at hand for comparison. Another comparison which is suggested is with *Hymenaea dakotana* Lesq.

The Milltown leaf, of which two specimens have been found, is more suggestive of *Phaseolites elegans* in general appearance than it is of the species with which it is identified. This is due to its more slender apical portion. On the other hand, it shows the very full convex base on one side, and the more acutely branching secondaries which are considered specific characters of *Phaseolites manhassetensis*.

OCCURRENCE: Milltown.

COLLECTIONS: U. S. National Museum.

Leguminosites raritanensis sp. nov.

Leaflets large, 7.5 cm. by 5.1 cm., almost a perfect ellipse in outline, slightly emarginate at the apex. Midrib thin and straight. Secondaries numerous, nearly straight, ascending at an angle of about 45° , camptodrome, of delicate calibre and scarcely discernible. [PLATE 18, FIGURE 4.]

This species is based upon a single individual and seems properly referable to this genus. In outline it suggests some of the forms which have been referred to *Populus* but its venation is quite different. It resembles also some of the specimens referred to *Liriodendropsis*, which is simply another way of emphasizing the fact that it is a leguminous leaflet of unknown generic affinities.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum.

Caesalpinia raritanensis sp. nov.

Elliptical leaflets about 3 cm. long and 2.2 cm. broad, with markedly emarginate apex. Midrib missing. Secondaries branching at a wide angle, almost 90° , and but slightly curved, anastomosing by broad evenly rounded loops about two thirds of the distance to the margin.

This is possibly only an extraordinarily large leaflet of *Caesalpinia Cookiana* Hollick, somewhat more elongated in outline and strictly congeneric with that species. It is, unfortunately, based upon a single imperfect specimen.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum.

Citrophyllum gen. nov.

Fossil spermatophytes with elliptical to ovate or ovate-lanceolate, coriaceous leaves, with entire or slightly undulate margins and stout conspicuously alate petioles. Secondary venation fine, more or less immersed, regular, camptodrome. Embracing leaves of the same general character as those of the modern genus *Citrus* and very similar to them.

Citrophyllum aligerum (Lesq.) comb. nov.

Ficus aligera Lesq. Fl. Dakota Group 84. *pl. 10. f. 3-6.* 1892.—
Berry, Rep. State Geologist [N. J.] for 1905, 139. 1906;
Bull. Torrey Club 33: 172. 1906.

Leaves small, elliptical to ovate or ovate-lanceolate, coriaceous, varying from 2.5 to 6 cm. in length by 1.8–3.2 cm. in breadth. Margin entire, occasionally slightly undulate. Apex rounded or obtusely acuminate. Base rounded, subtruncate or cuneate. Petiole stout, 0.7–2 cm. in length, conspicuously alate. The petiolar wings may be oblong-lanceolate or obovate; together they are from 2.5 to 5 mm. in width, averaging about 3.5 mm. Midrib stout. Secondaries fine, more or less obscured by the coriaceous leaf-substance, about 9 alternate pairs, branching from the midrib at angles of from 45 to 50°, parallel, camptodrome. [PLATE 18a, FIGURES 1–8.]

These curious leaves were described by Lesquereux from the Dakota group as a species of *Ficus* and compared with *Ficus bumelioides* Ettings. and *Ficus Mudgei* Lesq., neither of which has alate petioles, while the first has an emarginate apex. Subsequently, the same leaves were found in the Magothy formation of New Jersey and only recently a single small leaf was found in the Upper Raritan beds of South Amboy. They exhibit considerable variability in outline, but all have exactly the same aspect and conspicuous alate petioles. They appear to be related to the leaves of the modern genus *Citrus*. The latter have exactly the same texture and venation, the same variability in outline and marginal undulations, the same stout midrib and conspicuously alate petioles. In examining a suite of specimens of the latter and comparing them with the fossils the conclusion seems to be irresistible that they are related and the writer has consequently referred the fossils to a new genus with a name that emphasizes this relationship to the modern genus. All of the fossil specimens that are

at all complete are figured on PLATE 18a and two modern leaves are introduced for comparison. Possible arguments against the present view may be based on the theory that the modern alate petioles are derived from ancestors with compound leaves, in fact some modern species still have trifoliolate leaves and if this were true of the fossils as well it would require considerable rapidity of evolution in this genus previous to the Mid-Cretaceous. The modern leaves absciss from the top of the petiole and would be unlikely to occur as fossils with the petiole attached, neither can any indication of such an abscission line be made out in the fossils. This is the most difficult argument to combat. However, modern leaves are sometimes shed in their entirety and we are justified in predicating the occasional fall of leaves before maturity when the abscission layer of cells has not yet become weakened. The agency might be violent winds, the passage of large animals like some of the Cretaceous dinosaurs, or weakened conditions due to insect or fungus diseases.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum.

***Ilex amboyensis* nom. nov.**

Ilex? ovata Newb. Fl. Amboy Clays 98. *pl.* 18. *f.* 2. 1896.

Not Goepp. 1852.

Leaves small, broadly lanceolate, about 4 cm. in length by 2 cm. in breadth. Apex obtuse. Base narrowed and apparently acute. Margin beset with small and large subacute teeth. Midrib moderately stout and curved. Only a few secondaries are visible; these branch from the midrib at angles of about 45° and with but slight curving run directly to the marginal teeth.

This species was based on the single specimen figured by Professor Newberry (*loc. cit.*) and no additional specimens have come to light. Professor Newberry's name was a preoccupied one and the present name is given in allusion to the general locality.

OCCURRENCE: Sayreville.

COLLECTIONS: N. Y. Botanical Garden.

***Pterospermites obovatus* (Newb.) comb. nov.**

Protophyllum obovatum Newb. Fl. Amboy Clays 128. *pl.* 38. *f.* 4. 1896.

Leaf elliptical, about 12 cm. in length by 7.5 cm. in greatest breadth, which is near the middle. Margin entire. Midrib stout. Secondaries about 10 pairs, subopposite to alternate, comparatively slender and somewhat flexuous, camptodrome. Apex apparently rounded. Base contracted and then prominently auriculate, the three or four secondaries involved radiating from the base of the midrib.

This species is based upon a single specimen from Woodbridge, which Professor Newberry suggested may be related to the modern species of *Coccoloba*.

Very little can be said in favor of the reference of this leaf to Lesquereux's genus *Protophyllum*, all of the species of which differ from it in outline and marginal characters. Professor Newberry places great reliance upon the character of the base, but in the Raritan specimen this is decidedly auriculate and not subpeltate and the veins in this part of the leaf are radiate and not more or less parallel. Finally, the venation is distinctly camptodrome and not craspedodrome as it is in Lesquereux's definition of the genus and in all the other species which have subsequently been referred to it. For these reasons it is here placed in the genus *Pterospermites*, which seems to be a more natural arrangement. It may be compared with *Pterospermites auriculatus* Heer* of the Atane beds of Greenland which, while somewhat different in outline, is a leaf of the same general facies and is undoubtedly congeneric.

OCCURRENCE: Woodbridge.

COLLECTIONS: N. Y. Botanical Garden.

EUCALYPTUS ANGUSTA Velen.

Eucalyptus angusta Velen. Fl. Böhm. Kreidef. 4: 3. pl. 3. f. 2-12.

1885; Květena českého cenomanu 21. pl. 6. f. 1. 1889.—

Sap. Fl. Foss. Portugal 207. pl. 36. f. 12. 1894.

"Blätter lineal, schmal lineallanzettlich, in der Mitte oder in der unteren Hälfte am breitesten, ganzrandig, vorne in eine sehr lange Spitze vorgezogen und mit einem harten Dorn beendet. Der Primärnerv gerade, ziemlich stark, zur Spitze hin verdünnt. Die Secundärnerven zahlreich, unter spitzen Winkeln entspringend, am Rande durch einen Saumnerv untereinander verbunden. Der Blattstiel gerade, etwa 1 cm. lang, stark." Velenovsky, 1885.

The foregoing is Velenovsky's description of this interesting species, which is exceeding common at a number of localities in

* Heer, Fl. Foss. Arct. 6²: 95. pl. 27. f. 4. 1882.

the Perucér-schichten of Bohemia (Cenomanian), where the author subsequently found fruit-bearing twigs which he described and figured in 1889 and which, it would seem, conclusively establish the botanical relations of these leaves.

Subsequently, Saporta (*loc. cit.*) recorded this species from the Albian beds of Portugal; the latter material is, however, rather incomplete and open to question. Recent collections in our own coastal plain show that this species was present in considerable abundance on this side of the Atlantic at the same time that it flourished in Europe. It has been collected from the upper Raritan at South Amboy, where it is common, from the Bladen formation of South Carolina, and from the Upper Cretaceous of Georgia, and may be somewhat more fully characterized as follows:

Leaves alternate or scattered, mostly elongated, linear-lanceolate, often falcate, 4.5–15 cm. in length by 5–13.5 mm. in width, with an attenuated acute tip and a narrowly cuneate base declining to the short and stout petiole. Midrib moderately stout below, becoming attenuated above. Secondaries very numerous, fine, and close, about 1 mm. apart, parallel, rather straight; they branch from the midrib at acute angles of about 30° or slightly less and run with but slight curvature to join the well-marked but fine marginal hem, which shows in all the American material and in most of the illustrations of the foreign material. [PLATE 18, FIGURE 5.]

In all respects this is one of the most characteristically *Eucalyptus*-like species of the many which have been so identified; and its totality of characters combined with the presence of attached fruits in the Bohemian material, which are not unlike some of those of modern forms, renders the identification very satisfactory.

OCCURRENCE: South Amboy.

COLLECTIONS: U. S. National Museum.

***Andromeda Cookii* nom. nov.**

Andromeda flexuosa Newb. Fl. Amboy Clays 121. *pl.* 34. *f.* 1–5. 1896. Not Moon, 1849.

Leaves coriaceous, variable in size, lanceolate, 6–12 cm. in length by 1.5–3 cm. in width, with an acuminate apex and a somewhat cuneate base. Midrib stout and flexuous. Secondaries strong, somewhat flexuous, branching from the midrib at an acute angle and arching upward in long curves, camptodrome. Tertiaries mostly simple, transverse, forming oblong areoles.

This species is of the same general character as the other Raritan species of *Andromeda*, with which it is strictly congeneric. It is a common form in the Lower Raritan, although most of the specimens are imperfect. Elsewhere it is recorded from Glen Cove, Long Island, but the material from the latter locality is not very conclusive. The name given to this species by Newberry was unfortunately preoccupied and the name here used is given in honor of the late George H. Cook, whose work on the Raritan and allied formations has furnished the basis for all subsequent studies.

OCCURRENCE: Sayreville, Woodbridge, Milltown.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Myrsine Gaudini* (Lesq.) comb. nov.**

Myrsinites? Gaudini Lesq. Fl. Dakota Group 115. *pl.* 52. *f.* 4. 1892.

Myrsine elongata Hollick, Bull. Torrey Club 21: 54. *pl.* 177. *f.* 2. 1894. — Newb. Fl. Amboy Clays 122. *pl.* 22. *f.* 1-3. 1896.

Leaves oblanceolate or elongate-obovate, 5.5-7 cm. in length by 1.9-2.5 cm. in greatest width. Margin entire. Apex obtusely rounded. Base somewhat elongated, narrowly cuneate. Petiole present, stout. Midrib stout below, rapidly diminishing in calibre. Secondaries numerous, 8-10 pairs, alternate, branching from the midrib at angles of from 40° to 45°, camptodrome. When tertiary venation is distinctly preserved, the venation is more typical than when only the secondaries are partially visible.

This species is well distributed in the Raritan and has been recorded also from Long Island and Staten Island. The identification of *Myrsinites? Gaudini* Lesq. with the eastern forms with which it is obviously identical extends the range eastward from Kansas to Long Island. It may be readily distinguished from the other Raritan species by its relatively narrow elongated form. It is also present in undescribed collections of the writer from North Carolina and Alabama.

OCCURRENCE: South Amboy, Milltown.

COLLECTIONS: U. S. National Museum; N. Y. Botanical Garden.

***Diospyros amboyensis* nom. nov.**

Phyllites ellipticus Newb. Fl. Amboy Clays 130. *pl.* 24. *f.* 9. 1896.

Leaves elliptical, large, 8 cm. long by 4-6 cm. broad. Margin undulate. Apex rounded, almost retuse. Base broadly rounded,

thus differing from the wedge-shaped base of *D. primaeva*. Midrib strong, although not so strong as in the latter species. Secondaries numerous, 8–10 pairs, regular, leaving the midrib at an angle of about 45° , camptodrome. Tertiary venation of large polygonal meshes finer in calibre than in *D. primaeva*.

Unfortunately, no specimens other than Newberry's original type have been found and it is possible that it was an aberrant leaf of the common *Diospyros primaeva*, some undoubted leaves of which suggest it in their sum of characters. One of the leaves which Heer identifies from the Atane schists of Greenland as *Populus hyperborea*,* while the apex is partially destroyed and the tertiaries are not shown, is very similar to the species under discussion. This similarity does not extend, however, to the other leaves identified as this species. Newberry's specific name having already been used for a species of *Diospyros*, it becomes necessary to rename the Raritan plant.

OCCURRENCE: Woodbridge.

COLLECTIONS: N. Y. Botanical Garden.

***Acerates amboyensis* Berry**

Acerates sp. Hollick in Newb. Fl. Amboy Clays 124. *pl.* 32. *f.* 17; *pl.* 41. *f.* 4, 5. 1896.

Leaves narrow and elongated, somewhat falcate, lanceolate or linear-lanceolate, 5–7.5 cm. in length by 5–8 mm. in breadth, gradually narrowed above and cuneate below. Margin entire, somewhat undulate. Petiole apparently wanting. Texture thick. Secondaries numerous, rather angular, branching from the midrib at acute angles, camptodrome.

There is no reason why this species should not have a specific name, if only for purposes of intelligent citation. It is, however, perfectly distinct from the other members of the Raritan flora and is easily recognized. It is confined to the Upper Raritan in New Jersey but occurs in the Bladen formation of North Carolina. Several species of *Acerates* are described by Heer from the Greenland Cretaceous.

OCCURRENCE: South Amboy.

COLLECTIONS: N. Y. Botanical Garden.

* Heer, Fl. Foss. Arct. 3²: *pl.* 29. *f.* 6. 1874.

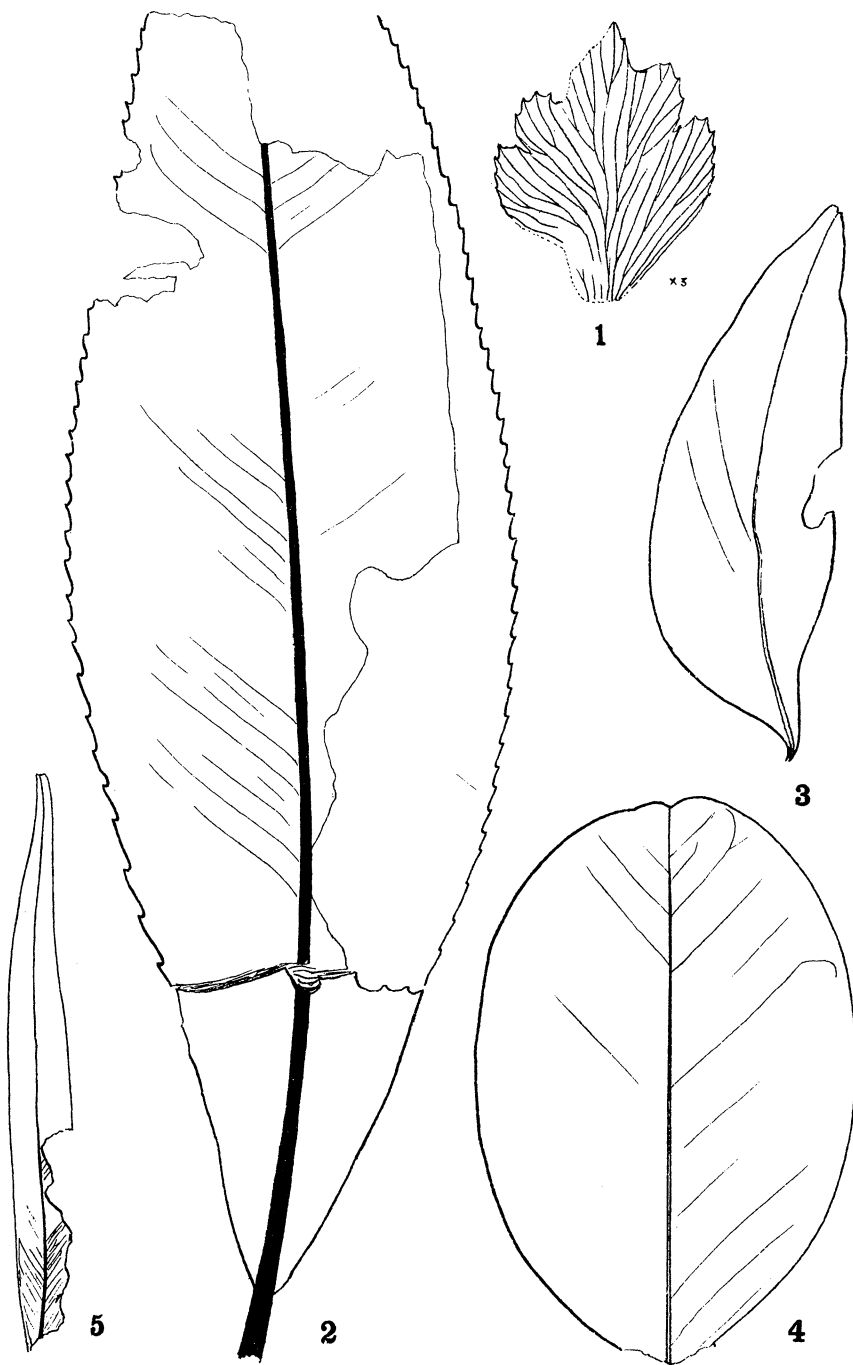
Explanation of plates 18 and 18a

PLATE 18

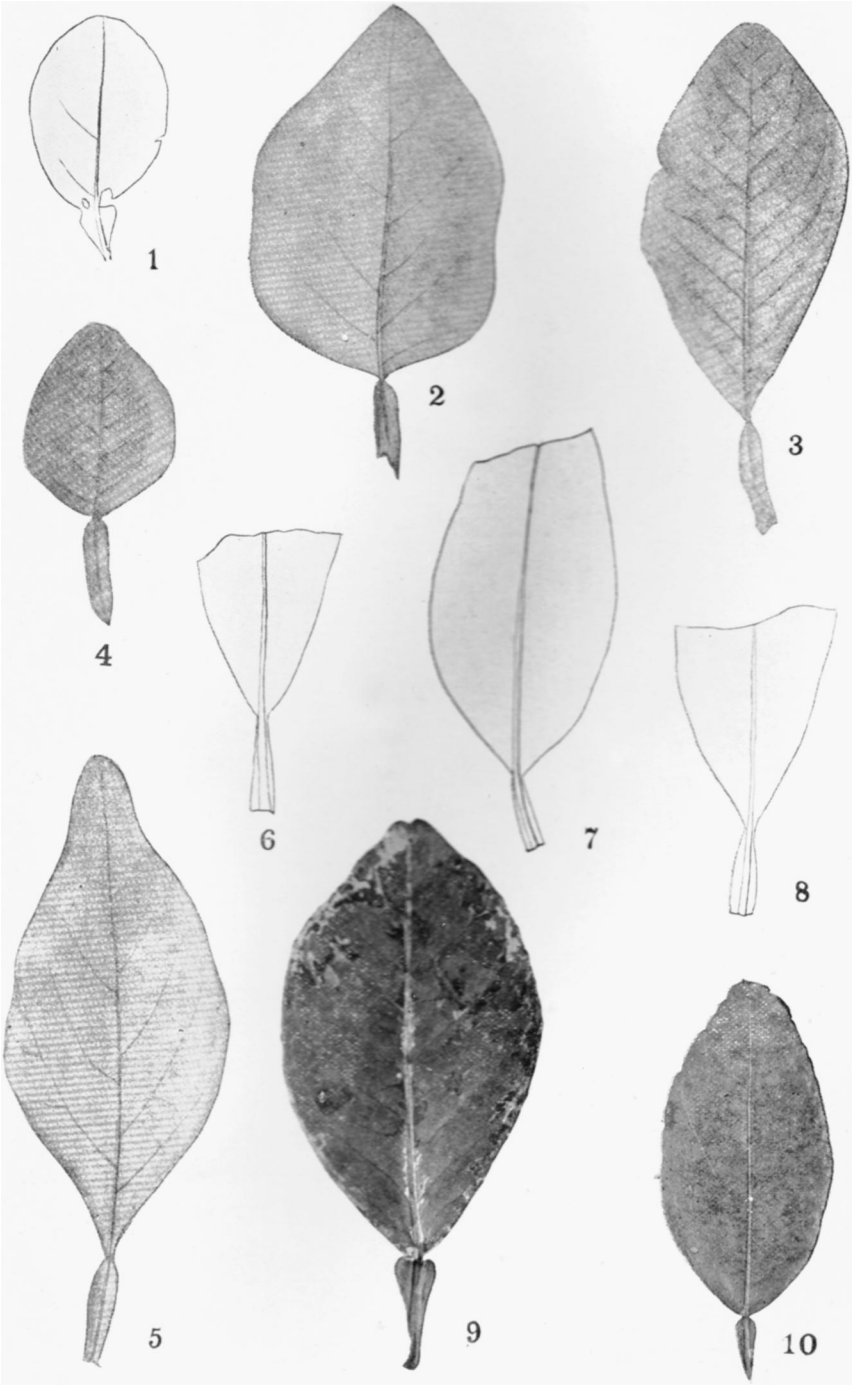
- FIG. 1. *Asplenium raritanense* sp. nov., Hylton Pits, N. J.
FIG. 2. *Myrica Hollicki* Ward, Milltown, N. J.
FIG. 3. *Phaseolites manhassetensis* Hollick, Milltown, N. J.
FIG. 4. *Leguminosites raritanensis* sp. nov., South Amboy, N. J.
FIG. 5. *Eucalyptus angusta* Velen., South Amboy, N. J.

PLATE 18a

- FIG. 1. *Citrophylllum aligerum* (Lesq.) Berry, South Amboy, N. J.
FIGS. 2-5. *Citrophylllum aligerum* (Lesq.) Berry, Cloud Co., Kansas.
FIGS. 6-8. *Citrophylllum aligerum* (Lesq.) Berry, Cliffwood Brick Company, N. J.
FIG. 9. *Citrus vulgaris* Risso, Florida.
FIG. 10. *Citrus Limonum* Risso, St. Croix.



BERRY, MESOZOIC FLORA OF ATLANTIC COSTAL PLAIN



BERRY, MESOZOIC FLORA OF ATLANTIC COASTAL PLAIN